

Effect of Digital Financial Services on Human Development in Nigeria

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Abstract

This study examines the effect of digital financial services on human development in Nigeria from 2009Q1 to 2024Q4, using the Human Development Index (HDI) as the measure of human development. Specifically, the study examines the effects of the values of Automated Teller Machine (ATM), Point-of-Sale (POS), and mobile payment transactions, alongside internet penetration. Quarterly data were sourced from the Central Bank of Nigeria, World Bank, and United Nations Development Programme. The study employed descriptive statistics, KPSS unit root tests, ARDL bounds cointegration tests, ARDL estimation, and diagnostic tests. The results revealed mixed orders of integration and confirmed the existence of long-run relationships between digital financial services and human development index. The findings revealed mixed effects. Internet penetration and ATM transaction values had positive and statistically significant short-run effects on HDI, while mobile payment transaction values had a positive and statistically significant long-run effect. Conversely, ATM transaction values exerted a significant negative long-run effect, while POS transaction values had a significant negative short-run effect. The error-correction coefficient was negative and approximately equal to unity, indicating rapid adjustment toward long-run equilibrium. The study concludes that digital financial services have heterogeneous effects on human development in Nigeria and recommends policies that promote inclusive, accessible, and productive digital financial services, particularly mobile payments and internet connectivity.

Keywords: Digital financial services; Human Development, Automated Teller Machine, Point-of-Sale, Mobile Payments, Internet Penetration

1. Introduction

The rapid diffusion of digital technologies has transformed the delivery and use of financial services, particularly in developing economies. Digital financial services (DFS) enable individuals and businesses to access and conduct financial transactions through technology-based channels such as automated teller machines (ATMs), point-of-sale (POS) terminals, mobile payment platforms, and internet-based services. By reducing transaction costs, improving the speed and convenience of payments, and extending financial services beyond conventional banking structures, DFS have the potential to promote financial inclusion and improve economic welfare. The development implications of digital finance are therefore not limited to financial-sector efficiency; they may also extend to broader dimensions of human development through improved access to economic opportunities, consumption smoothing, savings, and the provision of resources for education and health.

The relevance of these mechanisms to developing economies is supported by empirical evidence. For instance, Jack and Suri (2014) show that mobile money reduced the transaction costs associated with private transfers and improved households' ability to share risks in Kenya. Similarly, Suri and Jack (2016) find that the expansion of mobile money contributed to reductions in extreme poverty and improvements in economic outcomes over the long term. These findings suggest that digital financial technologies can influence welfare beyond their immediate function as payment instruments.

Nigeria provides an important setting for examining this relationship because of the rapid expansion of its digital-payment ecosystem. Data from the Central Bank of Nigeria (CBN) indicate substantial growth in the use of electronic payment channels. In 2023, ATM transactions amounted to about 1.01 billion transactions valued at ₦28.21 trillion, while POS transactions reached approximately 9.85 billion transactions valued at ₦110.35 trillion. Mobile-app transfers, excluding mobile money, reached 5.26 billion transactions valued at ₦219.80 trillion during the same year (Central Bank of Nigeria [CBN], 2024). The expansion continued during the first half of 2024, when POS transactions reached 6.40 billion in volume and ₦85.91 trillion in value, while mobile-app transactions reached 3.49 billion in volume and ₦159.42 trillion in value. ATM transactions during the same period amounted to 496.44 million, with a value of ₦12.21 trillion.

The expansion of digital financial activity has occurred alongside increasing digital connectivity. Internet access is particularly relevant because connectivity constitutes an important enabling condition for the adoption and effective use of many digital financial services. Nevertheless, the expansion of digital finance does not necessarily imply that its benefits are distributed equally across the population. Differences in income, geographical access, digital skills, financial literacy, infrastructure, and trust may affect the extent to which individuals can convert digital financial access into improvements in their economic and social well-being. This distinction is important for Nigeria, where substantial growth in digital financial transactions has occurred alongside persistent human-development challenges. The United Nations Development Programme (UNDP) reports that Nigeria's HDI was 0.548, placing the country in the low-human-development category and ranking it 161st in the 2023/24 Human Development Report. Although Nigeria's HDI increased by approximately 22% over the preceding 19 years, the country's level of human development remains relatively low (UNDP, 2024).

The coexistence of rapidly expanding digital financial services and relatively low human development raises an important empirical question concerning whether increased digital financial activity is actually associated with improvements in human development in Nigeria. While the literature provides evidence that digital finance can improve financial inclusion, risk-sharing, and household welfare, much of the existing empirical work has concentrated on outcomes such as financial inclusion, poverty reduction, consumption, or economic growth rather than the multidimensional measure of human development captured by the HDI. Consequently, there remains insufficient evidence regarding whether the expansion of specific digital financial channels translates into broader improvements in the health, education, and standard-of-living dimensions of human development.

This gap is particularly relevant because different digital financial channels may not have identical developmental effects. CBN data, for example, show that in the first half of 2024, POS transactions represented 28.53% of electronic-payment volume, mobile transactions represented 15.58%, and ATM transactions represented 2.21%, while internet/web transfers accounted for 51.91% of the volume. The considerable differences in the scale and nature of these channels suggest that aggregating digital financial services into a single measure may conceal potentially different relationships with human development.

Against this background, this study investigates the relationship between selected digital financial services indicators and human development in Nigeria. Specifically, it examines whether the value of ATM transactions, value of POS terminal transactions, value of mobile payment transactions, and the percentage of the population with internet access are associated with Nigeria's Human Development Index. By disaggregating digital financial services into specific indicators rather than treating them as a single aggregate phenomenon, the study seeks to provide empirical evidence on whether Nigeria's ongoing digital financial transformation is accompanied by corresponding improvements in human development.

2. Literature Review

Theoretical Review

Capability Approach

The Capability Approach, principally developed by Amartya Sen, originated with his 1979 Tanner Lecture, *Equality of What?* and was subsequently developed in *Commodities and Capabilities* (1985) and *Development as Freedom* (1999) (Sen, 1985, 1999). Its central assumption is that development should be evaluated not merely by income, commodities, or utility, but by the real capabilities or substantive freedoms that people possess to achieve valuable ways of living. Sen distinguishes between functionings, what people actually achieve—and capabilities—the opportunities they have to achieve those outcomes.

The approach is particularly relevant to this study because HDI reflects key dimensions of human development rather than income alone. Digital financial services may expand individuals' capabilities by reducing transaction costs, facilitating payments and transfers, improving access to economic opportunities, and enabling more effective management of financial resources. Accordingly, ATM, POS, mobile-payment services, and internet access may contribute to human development insofar as they expand people's economic opportunities and capabilities. The relationship, however, is not automatic because access to digital financial services must translate into meaningful opportunities and improved well-being.

Financial Inclusion Theory

Unlike the Capability Approach, Financial Inclusion Theory has no single founder or universally recognized year of formal proposition. It developed from the broader literature on financial access and financial development, with important contributions from Beck, Demirgüç-Kunt, and Levine (2007) and Demirgüç-Kunt, Beck, and Honohan (2008). The theory assumes that individuals and firms benefit when they can access and effectively use appropriate, affordable financial services. Financial inclusion therefore involves more than the physical availability of financial infrastructure; effective utilization is also important (Demirgüç-Kunt et al., 2008).

The theory suggests that greater financial inclusion can reduce transaction costs, facilitate payments and savings, improve risk management, support investment, and expand economic opportunities. In the context of this study, ATM transactions, POS transactions, mobile payment transactions, and internet access represent important dimensions of Nigeria's digital financial ecosystem through which financial services can become more accessible and usable. The theory therefore provides the mechanism linking digital financial services to improved socioeconomic welfare, while the Capability Approach explains how such improvements may ultimately contribute to human development.

Empirical Review

Eizaguirre et al. (2025) examined the reasons behind the inconsistent implementation of citizen-centric e-governance throughout the European Union, despite significant digitalisation initiatives. The research investigated the impact of digital infrastructure, governmental

openness, and mobile adaptability on public trust and engagement in digital civic services. The research employed ordinary least squares (OLS) regression models to examine country-specific data from 27 EU member nations, utilising information from the EU Digital Economy and Society Index (DESI), the World Bank, and the World Health Organization. Four distinct models evaluated the impact of internet penetration, fixed broadband availability, transparency, and mobile compatibility on the acceptance and trust in e-government. The results indicated that internet penetration was a considerably more robust predictor of e-government utilisation than fixed broadband availability, thereby underscoring the necessity for comprehensive digital access policy. Transparency exhibited a favourable correlation with the adoption of e-government; nevertheless, it did not directly foster trust, which was instead elucidated by more extensive socioeconomic factors as the Human Development Index (HDI). Mobile compatibility improved engagement in digital services aimed at citizens, whereas its impact on those directed at businesses was less pronounced. The results endorsed the implementation of mobile-centric design approaches, equity-focused access policies, and the incorporation of transparency in wider development efforts. The research offered a framework for inclusive and trust-centric digital governance within various European Union settings, while reconciling discrepancies between theoretical constructs of digital governance and their actual application. Ilarslan (2024) investigated the influence of the shadow economy (SE), Human Development Index (HDI), automated teller machine (ATM) utilisation, and inflation (INF) on access to financial services (AFS) within the member nations of the Organization of Turkic States (OTS). The research spans from 2004 to 2021 and employs the fixed-effect Method of Moment Quantile Regression (MM-QR) for its analysis. The results indicated that HDI levels and ATM utilisation had a beneficial impact on access to financial services, whereas the shadow economy had an adverse effect. Despite inflation adversely affecting access to financial services, this impact could not be substantiated at any quantile level.

Asongu and Odhiambo (2018) evaluated the human development benchmarks at which mobile banking alleviated poverty and inequality in 93 developing nations in 2011. Mobile banking encompassed actions like utilising mobile devices for bill payments and transferring funds, whereas the Human Development Index (HDI) functioned as the policy adjustment metric. The empirical examination utilised interactive quantile regressions. The results indicated that when human development levels rise, the utilisation of mobile phones for bill payments aids in diminishing inequality among nations situated at both the lower and upper extremes of the inequality spectrum. In a similar vein, mobile phones utilised for monetary transactions fostered inclusive growth across almost all poverty strata, with the exception of the top decile. The adjusted thresholds of HDI varied between 0.542 and 0.632 under inequality criteria and from 0.333 to 0.705 under poverty criteria.

Onyia et al. (2025) investigated the synergistic impact of remittance inflows and digital technology on the Human Development Index (HDI) within Sub-Saharan Africa. The research utilised conditional panel quantile regression techniques with panel data from forty-five Sub-Saharan African nations spanning the years 2010 to 2022. The results indicated that the impact of remittances and digital technologies on Human Development Index (HDI) differed among nations based on their respective HDI standings. Moreover, the interplay between remittances and digital technologies shown significant differences among nations with low HDI (25th quantile), medium HDI (50th quantile), and high HDI (75th quantile). The cumulative impacts were most pronounced in nations positioned at the median HDI tier. The research suggested that nations in Sub-Saharan Africa implement consumer-focused digital platforms for remittance services, supported by sufficient security protocols, to boost remittance inflows and promote human development outcomes in light of digital technology improvements. The research determined that when remittances emerged as significant sources of foreign financial

inflows, understanding the factors influencing these remittance flows was crucial for enhancing HDI in Sub-Saharan Africa.

Aninwagu and Onyema (2025) examined the relationship between financial inclusion and economic resilience in Nigeria from 1990 to 2023, The OLS analysis indicated a negative and statistically significant relationship between the inflation rate and GDP growth, with a coefficient of -0.119173. This suggests that a one unit increase in the inflation rate leads to a decrease in GDP growth by approximately 0.119173 units in the long run. Furthermore, the results showed a negative and statistically significant impact of internet usage on GDP growth, with a coefficient of -0.098994, indicating that increased internet penetration is associated with a reduction in GDP growth in Nigeria. Additionally, the analysis showed that the SME financing has a positive but not statistically significant impact on GDP growth, with a unit increase in SME financing leading to an increase in GDP growth by 0.904737 units

3. Methodology

This study adopts an ex-post facto design. This is because it is deemed suitable, as the research depends on pre-existing macroeconomic and financial data that researchers cannot alter. The data for this study was sourced from the World Bank's World Development Indicators (WDI), United Nations Development Program Human Development Reports, and the Central Bank of Nigeria Statistical Bulletin from the first quarter of 2009 to the fourth quarter of 2024. The modelling of this study was theoretically anchored in Sen's capability approach.

The study specifies the following models:

$$HDI = f(ATMV, POSV, MOBV, INTP) \quad 3.1$$

$$HDI_t = \beta_0 + \beta_1 \ln ATMV_t + \beta_2 \ln POSV_t + \beta_3 \ln MOBV_t + \beta_4 \ln INTP_t + \varepsilon_t \quad 3.2$$

$$\begin{aligned} \Delta HDI_t = & \alpha_0 + \sum_{i=1}^p \alpha_1 \Delta HDI_{t-1} + \sum_{i=1}^q \alpha_2 \Delta \ln ATMV_{t-1} + \sum_{i=1}^q \alpha_3 \Delta \ln POSV_{t-1} \\ & + \sum_{i=1}^q \alpha_4 \Delta \ln MOBV_{t-1} + \sum_{i=1}^q \alpha_5 \Delta \ln INTP_{t-1} + \lambda_1 HDI_{t-1} + \lambda_2 \ln ATMV_{t-1} \\ & + \lambda_3 \ln POSV_{t-1} + \lambda_4 \ln MOBV_{t-1} + \lambda_5 \ln INTP_{t-1} + \varepsilon_{1t} \end{aligned}$$

Where:

HDI_t = Human Development Index (HDI)

$\ln ATMV_t$ = Logarithm value of ATM transactions

$\ln POSV_t$ = Logarithm value of POS terminal transactions

$\ln MOBV_t$ = Logarithm value of mobile payment transactions

$INTP_t$ = Internet penetration rate

β_0 = Constant term; $\beta_1 - \beta_4$ = Parameters to be estimated; ε_t = Stochastic error terms; and t = Time period; α_0 = constant parameter to be estimated; $\alpha_1 - \alpha_5$ = short run parameters; $\lambda_1 - \lambda_5$ = long-run multipliers; p = optimal lag for each of the dependent variables; q = optimal lag of the independent variables; Δ = first difference operator; ε_{1t} = error terms.

NOTE: The logarithmic transformation of selected explanatory variables is intended to normalize the data, reduce heteroskedasticity, and interpret coefficients in elasticity terms.

A priori Expectation

$HDI_t = \beta_1 > 0, \beta_2 > 0, \beta_3 > 0, \beta_4 > 0.$

4. Data Analysis

Table 4.1: Summary of descriptive statistics for the variables

	HDI	INTP	LNATM	LNMOBV	LNPOSV
Mean	0.530000	25.53937	8.576571	7.030039	7.001731
Median	0.530000	25.01000	8.642363	6.817057	6.941606
Maximum	0.560000	41.21000	10.39354	12.88083	12.31615
Minimum	0.500000	9.300000	5.990739	0.239017	2.400619
Std. Dev.	0.019485	9.968066	1.320651	3.702217	3.044097
Skewness	3.13E-17	0.055795	-0.331027	-0.066666	0.132146
Kurtosis	1.875000	1.884671	2.283361	2.040476	1.981482
Jarque-Bera	3.164063	3.350432	2.538363	2.502570	2.952610
Probability	0.205557	0.187268	0.281062	0.286137	0.228480
Sum	31.80000	1634.520	548.9005	449.9225	448.1108
Sum Sq. Dev.	0.022400	6259.828	109.8794	863.5039	583.7911
Observations	60	64	64	64	64

Source: Researcher's computations using Eviews 12, (2026)

The summary statistics in Table 4.1 indicate that the mean value for the human development index (HDI) is 0.69%, with minimum and maximum values of 0.50 and 0.56, respectively. The internet penetration rate (INTP) and the logarithm of the value of ATM transactions (LNATM) recorded average values of 25.53% and 8.57, respectively. INTP had minimum and maximum values of 9.30% and 41.21%, while LNATM ranged from 5.99 to 10.39.

Further, the logarithm of the value of mobile payment transactions (LNMOBV) and the logarithm of the value of POS terminal transactions (LNPOSV) had mean values of 7.03 and 7.00, respectively. LNMOBV ranged from 0.23 to 12.88, whereas LNPOSV varied between 2.40 and 12.31.

The standard deviations indicate that the data for all variables are concentrated around their respective means. The outcomes of the Jarque-Bera test demonstrate that all variables exhibit normal distribution, as shown by the JB and p-values exceeding 0.05.

Table 4.2 KPSS Unit Root Test

Variables	KPSS at Level	Critical value 5%	KPSS at 1 st Diff.	Critical value 5%	Order of Integration
HDI	0.085697	0.146000	NA	NA	1(0)
LNATM	0.967625	0.463000	0.099434	0.463000	1(1)
LNMOBV	1.010639	0.463000	0.164124	0.463000	1(1)
LNPOSV	1.005903	0.463000	0.174748	0.463000	1(1)
INTP	0.105325	0.146000	NA	NA	1(0)

Source: Researcher's computation using Eviews 12 (2026).

The KPSS unit root test findings presented in Table 4.2 indicate that only the logarithmic figures of ATM transactions (LNATM), mobile payment transactions (LNMOBV), and POS terminal transactions (LNPOSV) exhibit non-stationarity, specifically a unit root. The KPSS values of 0.967625, 1.010639, and 1.005903 exceed the critical threshold of 0.463000 at a 5% significance level. However, an examination of the first differences of these variables confirms their stationarity, as their KPSS values of 0.099434, 0.164124, and 0.174748 fall below the

5% significance level. This result indicates that these variables attain stationarity after differentiation. Additionally, the supplementary variables analyzed demonstrate stationarity in their original forms. Consequently, the series used in this research comprises a combination of I(1) (integrated of order 1) and I(0) (integrated of order 0) variables, as illustrated in the table above.

Table 4.3: Bounds cointegration test results for the models

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	7.036918	10%	3.03	4.06
K	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72

Source: Researcher's computation using Eviews 12, (2026).

Note: K denotes the number of independent variables.

The results presented in Table 4.3 demonstrate that the F-statistics for these models, 7.036918, exceed the critical values at both the lower and upper bounds at a 5% significance level. This indicates a strong relationship between the dependent variable and the independent variables.

Model Result and Discussion

Table 4.4: ARDL short- and long-run results of HDI

Dependent Variable: HDI

Short run results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.488609	0.078363	6.235231	0.0000
@TREND	0.000568	9.16E-05	6.205782	0.0000
D(HDI(-1))	0.515094	0.138720	3.713191	0.0007
D(HDI(-2))	0.465464	0.110060	4.229172	0.0001
D(HDI(-3))	0.408620	0.104009	3.928691	0.0003
D(INTP)	0.001526	0.000627	2.434513	0.0197
D(INTP(-1))	0.000246	0.000662	0.371872	0.7121
D(LNATM)	0.003198	0.001191	2.685165	0.0107
D(LNATM(-1))	-0.000307	0.001290	-0.237826	0.8133
D(LNMOBV)	0.001541	0.001334	1.154899	0.2553
D(LNMOBV(-1))	-3.69E-05	0.001283	-0.028789	0.9772
D(LNPOSV)	-0.000674	0.001305	-0.515941	0.6089
D(LNPOSV(-1))	-0.000497	0.001309	-0.379714	0.7063
CointEq(-1)*	-1.001644	0.160622	-6.236043	0.0000
Long run results				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTP	-6.66E-05	0.000342	-0.194761	0.8466

LNATM	-0.001780	0.000768	-2.317828	0.0257
LNMOBV	0.004796	0.000977	4.910919	0.0000
LNPOSV	-0.001328	0.000770	-1.724153	0.0924

R-squared 0.776106; Adjusted R-squared 0.706806

Source: Researcher's computation using Eviews 12 (2026).

Table 4.4 displays the ARDL findings for both short- and long-term, clarifying the relationship between the Human Development Index (HDI) and several digital financial service variables in the study. These results illustrate the prompt and lasting effects of these factors on the Human Development Index (HDI) in Nigeria.

In the immediate term, the coefficient for the internet penetration rate for both the current and preceding years exhibits a positive and statistically significant impact on Nigeria's HDI, indicating that a one-unit rise in internet penetration correlates with a 0.001 unit increase in HDI in the short run. These results align with the study's initial idea. In the long run, it indicates a detrimental effect with no statistically significant influence on HDI, suggesting that a one-unit rise leads to a reduction of HDI in Nigeria by -6.66 units.

The immediate and extended results indicate that the coefficient for the logarithm of ATM transaction values in the present year has a statistically significant beneficial effect on the HDI. A 1% fluctuation in ATM transactions elevates Nigeria's HDI by 0.0002 units in the short term. At lag 1 period, it has an adverse influence without a statistically meaningful effect on HDI in Nigeria. Conversely, the long-term outcome coefficient exhibits a statistically significant inverse relationship with the HDI, indicating that a 1% variation results in an estimated decline of -0.001 units in Nigeria's HDI. The outcomes oppose the study's initial anticipations yet validate the empirical results of Awodiran et al. (2024).

The coefficient for the logarithm of mobile payment transaction values for the current year and the preceding period demonstrated a negative influence with no statistically significant effect on HDI in Nigeria. In contrast, the long-term outcomes coefficient revealed a statistically significant positive effect on Nigeria's HDI, indicating that a 1% change in the logarithm of mobile payment transaction values leads to a 0.004-unit rise in HDI. This discovery corresponds with the study's initial hypotheses and empirical findings. These findings align with the study's initial concept.

The logarithm of the coefficient for POS terminal transaction values from the current and previous year demonstrates a statistically significant adverse effect on Nigeria's Human Development Index (HDI), indicating that a 1% change in the logarithm of POS terminal transaction values leads to a decrease in Nigeria's HDI in the short term. The long-term results coefficient exhibits a negative relationship with no statistically significant impact on the HDI, suggesting that a 1% alteration in the logarithm of POS terminal transaction values diminishes Nigeria's HDI by -0.001 units. This discovery opposes the study's initial hypotheses and the empirical findings of Firdauzi & Sukmana (2020), who observed a beneficial impact on HDI. The negative and statistically significant coefficient of the CointEq(-1) error correction term, recorded at -1.001644, indicates that the system corrects short-time departures from long-run equilibrium with virtually complete efficiency. The high R-squared value (0.776106) signifies that 77% of the variation in the HDI is explained by the model's independent variables. The modified R-squared value (0.706806) confirms the model's strength, even when accounting for the quantity of predictors.

Table 4.5: Post-Estimation Tests Results

Test	Null Hypothesis	F-Statistic	Probability	Decision
Breusch-Godfrey Serial Correlation LM	H_0 : No serial correlation	1.500930	0.2358	Retain H_0
Breusch-Pagan-Godfrey Heteroskedasticity Test	H_0 : Homoscedasticity	1.708921	0.0946	Retain H_0
Jarque-Bera Normality Test	H_0 : Normally distributed	3.317155	0.190410	Retain H_0

Source: *Researcher's Computation using Eviews 12, 2026.*

The post-estimation diagnostic results presented in Table 4.5 indicate that the estimated ARDL model does not exhibit evidence of the major residual problems examined. The Breusch–Godfrey LM test reports an F-statistic value of 1.500930 and a probability value of 0.2358, which is greater than the 5% significance level. Therefore, the null hypothesis of no serial correlation fails to be rejected, suggesting that the residuals do not exhibit statistically significant serial correlation.

Similarly, the Breusch–Pagan–Godfrey heteroskedasticity test produces an F-statistic value of 1.708921 and a probability value of 0.0946, which exceeds 0.05. Thus, the null hypothesis of homoskedasticity cannot be rejected, indicating no statistically significant evidence of heteroskedasticity in the residuals.

The Jarque–Bera test reports a statistic of 3.317155 with a probability value of 0.190410. Since the JB value and the probability value exceed 0.05, the null hypothesis of normally distributed residuals cannot be rejected. Hence, there is no statistically significant evidence that the residuals depart from normality.

5. Conclusion and Recommendations

Conclusion

This study examined the effects of selected digital financial services indicators on human development in Nigeria using the ARDL approach. The findings reveal mixed effects across the short and long run. Internet penetration and ATM transaction values positively and significantly affected HDI in the short run, while mobile payment transactions had a positive and significant long-run effect. Conversely, ATM transactions had a significant negative long-run effect, while POS transactions negatively and significantly affected HDI in the short run. Overall, the findings suggest that digital financial services do not automatically improve human development; their impact depends on the type and effective utilization of the services. Strengthening inclusive and productive digital financial services, particularly mobile payments and internet access, is therefore essential for translating Nigeria's digital financial expansion into sustainable human-development gains.

Recommendations

Based on the findings and conclusion drawn from this study, the following recommendations are made:

- i. The government should invest in reliable and affordable internet infrastructure, particularly in underserved areas, given the positive and statistically significant short-run effect of internet penetration on HDI.
- ii. Policies should support secure, affordable, and accessible mobile payment services because mobile payment transaction values have a positive and statistically significant long-run effect on HDI.
- iii. Policymakers should shift emphasis from increasing ATM transaction volumes to

ensuring that ATM services facilitate broader financial inclusion and productive economic activities.

iv. Government should encourage POS services that support productive transactions, small-business activity, and financial inclusion rather than focusing solely on transaction growth.

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